

REMARKS

Claims 1 and 4-24 were examined and rejected. Claims 1, 4 and 8 have been amended. Claims 33-36 are added. Reconsideration of the claim rejections is requested in view of the following claim amendments and remarks.

Claims Rejected Under 35. U.S.C. §102

The Patent Office rejects Claims 1, 4-9, 11-14, and 16-24 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,695,810 issued to Dubin, et al. ("Dubin"). Applicants respectfully traverse this rejection.

Applicants respectfully assert that the Patent Office has failed to adequately set forth a *prima facie* rejection under 35 U.S.C. §102(b). "Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, *arranged as in the claim.*" *Lindemann Maschinenfabrik v. American Hoist & Derrick* ("Lindemann"), 730 F.2d 452, 1458 (Fed. Cir. 1994)(emphasis added). Additionally, each and every element of the claim must be exactly disclosed in the anticipatory reference. *Titanium Metals Corp. of American v. Banner* ("Banner Titanium"), 778 F.2d 775, 777 (Fed. Cir. 1985).

Applicants submit that Claim 1, as amended, includes the following feature which is neither taught nor suggested by the Dubin reference:

introducing a barrier material in an opening through a dielectric over a contact point;

introducing a conductive shunt material on the barrier material through a chemically induced oxidation-reduction reaction.

Dubin describes a technique for electrolessly depositing a cobalt tungsten phosphate (CoWP) barrier material onto copper and electrolessly depositing copper onto the CoWP barrier material to prevent copper diffusion when forming layers and/or structures on a semiconductor wafer. (Abstract) Dubin relates to the formation of a electrolessly deposited CoWP barrier material on a base of a trench, as depicted in FIG. 8 of Dubin, or along both the base and sidewall of the trench, as depicted in FIG. 4 of Dubin.

Claim 1, as amended, requires introduction of a conductive shunt material through a chemically-induced oxidation-reduction reaction on a barrier material formed in an opening through a dielectric over a contact point, as depicted in Applicants' FIG. 4. Consequently, Applicants submit that the Patent Office has failed to establish a *prima facie* rejection of Claim 1, as amended, under 35 U.S.C. §102(b). Consequently, Applicants respectfully request that the Patent Office withdraw the §102(b) rejection of Claim 1.

Claims 4-9 and 11-14

Applicants respectfully submit that Claims 4-9 and 11-14 depend from Claim 1 and, therefore, include the patentable features of Claim 1, as described above. As a result, Claims 4-9 and 11-14 are patentable over the references of record for at least the reasons described above. Consequently, Applicants respectfully request that the Patent Office withdraw the 35 U.S.C. §102(b) rejection of Claims 4-9 and 11-14.

Claims 16-24

Claims 16-24 depend from independent Claim 15, which was not rejected under 35 U.S.C. §102(b) by the Patent Office. As a result, Claims 16-24 are patentable over Dubin based on the fact that they depend from Claim 15, which is indicated by the Patent Office to be patentable over Dubin. Consequently, Applicants respectfully request that the Patent Office withdraw the 35 U.S.C. §102(b) rejection of Claims 16-24.

Claims Rejected Under 35. U.S.C. §103

The Patent Office rejects Claims 1 and 4-24 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,674,787 issued to Zhao, et al. ("Zhao"), in view of Yoshio, et al. '770 ("Yoshic"). Applicants respectfully traverse this rejection.

To establish a *prima facie* case of obviousness, the following criteria must be met: (1) there must be some suggestion or motivation to modify the reference or combine the reference teachings, (2) there must be a reasonable expectation of success, and (3) the prior art references must teach or suggest all the claim limitations. (MPEP 2142) For

the reasons provided below, the Patent Office has failed to establish a *prima facie* case of obviousness in view of the references of record.

Zhao teaches a technique for activating the surface of a TIN layer 13 by method of contact displacement of copper, as depicted in FIG. 4 of Zhao. As depicted in FIG. 1 of Zhao, a via 15 is opened within an interlayer dielectric to expose a barrier layer 13 formed on a metal layer 11. As depicted with reference to FIGS. 1-6 of Zhao, a dielectric layer 16 may be formed over the interlayer dielectric and via, which is then etched such that the dielectric layer 16 remains on vertical sidewalls of via 15. Next, as depicted in FIG. 4, copper layer 21 is formed over barrier layer 13 to activate the barrier layer 13 in order for electroless deposition of copper plug 23 and the formation of a barrier cap layer 24, as depicted in FIG. 6.

In a further embodiment, as depicted in FIG. 7, the structure of FIG. 7 is equivalent to the structure of FIG. 1 except that the exposed TIN layer 13 and the via opening 15 has been etched away during the etch process for creating the via opening 15. (Col. 9, lines 1-15) In FIGS. 9 and 10 of Zhao, a dielectric layer 16 is reintroduced and etched which remains along the sidewalls 17 of via opening 15, as depicted in FIG. 9. Subsequently, a seed layer is deposited on metal layer 11 to form barrier layer 19, as illustrated in FIG. 10. The barrier layer 19 is activated using activation layer 28, as depicted in FIG. 11 to enable electroless deposition of copper to form copper pug 23, as depicted in FIG. 12.

In other words, the barrier layer 13 of FIGS. 1-6 is reformed as barrier layer 19, as depicted in FIGS. 11 and 12.

Claim 1 describes the formation of a conductive shunt material 280 on a barrier material 240, as depicted in FIG. 1. In addition, an electroless seed material 290 may be formed over the conductive shunt material 280, as depicted in FIG. 5 prior to introduction of interconnection material 260, as depicted in FIG. 6. Applicants submit that these features are neither taught nor suggested by Zhao.

However, according to the Patent Office, modification of Zhao in view of Yoshio renders Claim 1 obvious. Yoshio describes a pretreatment for electroless plating (col. 7,

lines 38 and 39). The Patent Office cites the text from col. 7, line 38 through col. 8, line 34 to illustrate that the presence of an alkaline metal-free reducing agent in an electroless plating process. Applicants submit that Yoshio fails to rectify the failure of Zhao to teach the formation of a conduction shunt material on a barrier material, as required by Claim 1.

Consequently, Applicants submit that modification of Zhao in view of Yoshio fails to teach the introduction of a conductive shunt material on a barrier material in an opening through a chemically-induced oxidation-reduction reaction, as required by Claim 1. Therefore, Applicants respectfully submit that the Patent Office has failed to establish a *prima facie* rejection over Zhao in view of Yoshio. Accordingly, Applicants respectfully request the Patent Office withdraw the §103(a) rejection of Claim 1.

Claims 4-14

Claims 4-14 depend from Claim 1 and, therefore, include the patentable limitations of Claim 1. Accordingly, for at least the reasons provided above, Applicants respectfully submit that Claims 4-14 are patentable over the references of record. Accordingly, Applicants respectfully request the Patent Office withdraw the §103(a) rejection of Claims 4-14.

Claim 15

Applicants submit that Claim 15 includes the following features which are neither taught nor suggested by the references of record:

introducing a conductive shunt material in an opening through a dielectric to a contact point, wherein the opening defines a via having a cross-sectional area and a volume, and a trench to the via having a cross-sectional area greater than the cross-sectional area of the via;

introducing an interconnect structure material on the conductive shunt material;

introducing a conductive shunt material precursor having an oxidation number on an exposed surface of the interconnect structure; and

reducing the oxidation number of the shunt material precursor.

[Emphasis added]

However, according to the Patent Office, modification of Zhao in view of Yoshio renders Claim 15 obvious. Yoshio describes a pretreatment for electroless plating (col. 7, lines 38 and 39). The Patent Office cites the text from col. 7, line 38 through col. 8, line 34 to illustrate that the presence of an alkaline metal-free reducing agent in an electroless plating process. However, after careful review of the text cited by the Patent Office, Applicants respectfully submit that Yoshio does not provide any teachings as to a shunt metal precursor having an oxidation number and reducing the oxidation number of the shunt material precursor.

Furthermore, Claim 15 requires the introduction of a shunt material in an opening through a dielectric to a contact point wherein the opening defines a via having a cross-sectional area and a volume and a trench to the via having a cross-sectional area greater than the cross-sectional area of the via. Applicants submit that the cited references are limited to electroless deposition of copper within a via having an electrolessly deposited barrier layer at the base of the via.

Accordingly, Applicants respectfully submit that the Patent Office has failed to establish a *prima facie* rejection of Claim 15 over Zhao in view of Yoshio, since the cited references, in combination, fail to teach each of the claim limitations of Claim 15. Consequently, for at least the reasons provided above, Applicants respectfully submit that Claim 15, as amended, is patentable over the references of record. Therefore, Applicants respectfully request that the Patent Office withdraw the §103(a) rejection of Claim 15.

Claims 16-24

Claims 16-24 depend from Claim 15 and, therefore, include the patentable limitations of Claim 15, as described above. Accordingly, Applicants respectfully submit that Claims 16-24 are patentable over the references of record. Therefore, Applicants respectfully request that the Patent Office withdraw the §103(a) rejection of Claim 16-24.

New Claims 33-36

Claims 33-36 are patentable over the references of record due to their feature of introducing a conductive shunt material within a via having an overlying trench within

a dielectric to a contact point in an amount to substantially fill the via. This feature is neither taught nor suggested by the references of record. Accordingly, Applicants respectfully submit that Claims 33-36 are patentable over the references of record.

CONCLUSION

In view of the foregoing, it is submitted that Claims 1, 4-24, and 33-36 patentably define the subject invention over the cited references of record, and are in condition for allowance and such action is earnestly solicited at the earliest possible date. If the Patent Office believes a telephone conference would be useful in moving the case forward, he is encouraged to contact the undersigned at (310) 207-3800.

If necessary, the Commissioner is hereby authorized in this, concurrent and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2666 for any additional fees required under 37 C.F.R. §§1.16 or 1.17, particularly, extension of time fees.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to: Box Non-Fee Amendment, Assistant Commissioner for Patents, Washington, D.C. 20231 on April 11, 2003.

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